U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN No. 23.

B. T. GALLOWAY, Chief of Bureau.

BERSEEM:

THE GREAT FORAGE AND SOILING CROP OF THE NILE VALLEY.

BY

DAVID G. FAIRCHILD,
AGRICULTURAL EXPLORER FOR SEED AND PLANT INTRODUCTION.

ISSUED AUGUST 30, 1902.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1902.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., May 20, 1902.

Sir: I have the honor to transmit herewith a paper on Berseem: The Great Forage and Soiling Crop of the Nile Valley, and respectfully recommend that it be published as No. 23 of the Bureau series of bulletins. The paper was prepared by Mr. David G. Fairchild, agricultural explorer, Seed and Plant Introduction, and was submitted by the assistant in charge of Seed and Plant Introduction.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

PREFACE.

One of the most important duties of an agricultural explorer is the observation of methods of agriculture practiced in other countries, that show promise of having value if transferred to parts of the United States. Mr. David G. Fairchild has made some careful observations upon Egyptian agriculture with reference to its adaptability to parts of the irrigated Southwest, the accompanying article on berseem being one of the results of this study. It is not to be expected that every agricultural practice followed in Egypt can be bodily transferred to the United States, but it seems probable that at least for certain conditions this great Egyptian forage crop may prove of extreme value.

ERNST A. BESSEY,
Assistant in Charge of Seed and Plant Introduction.

OFFICE OF SEED AND PLANT INTRODUCTION,
February 6, 1902.

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BERSEEM: THE GREAT FORAGE AND SOILING CROP OF THE NILE VALLEY.

INTRODUCTION.

There are few countries in the world to-day where agriculture pays better than it does in Egypt. The methods of plowing and seeding have scarcely changed at all since the days of the ancient Egyptians, and yet without a single manufacturing industry worthy the name the valley of the Nile is entering upon an era of growth and prosperity which seems most remarkable even to an inhabitant of the Western Hemisphere.

While her great money-making crop is cotton, in the production and shipment of which she has much to teach her competitors, the foundation of her continued prosperity rests upon a leguminous fodder and soiling crop, about which the outside world has concerned itself very little.

Berseem, Alexandrian clover, or Egyptian clover (Pl. I), as it is variously called, is a species of Trifolium more or less closely related to the ordinary red clover. Its name, *Trifolium alexandrinum* L., probably has nothing to do with its origin; in fact there is good reason to believe that the plant came from some other part of the Mediterranean than that about Alexandria, and was introduced into Egypt in comparatively recent times. The total absence on the monuments of any bas relief which can be identified as this plant is remarkable if the species occupied in those days the important place it does now in the agriculture of the peasants or fellahin. There are few single species of plants which play in any country a more important rôle in its agriculture than is played by this Trifolium. It is the first crop planted after reclaiming the salt lands (Pl. II, figs. 1, 2, 3); it furnishes the green fodder for all work animals in the big towns (Pl. V, fig 1); on it graze all the beef and milch cattle (Pl. III, figs. 1, 2, 3); the camels are fed upon it (Pl. VI, fig. 2); the well-kept donkeys get their portion of it, and even the poor fellah carries a bunch of it in his hand and seems to enjoy its sharp clover taste. Nothing among the most varied agricultural sights which interest the tourist in Egypt in winter can be more conspicuous than the culture, harvest, and marketing of this essentially green-fodder crop. Every coachman has a bunch of

berseem or a bag full of it under his feet with which he feeds his horse at the cab stand; every drayman has on top of his load a few handfuls for his bullocks or horses, and the donkey boys carry a bag of the freshly cut clover for their much-abused beasts. In the early morning all the avenues leading to Cairo are lined with long files of camels and donkeys half hidden under loads of this green forage. (Pl. IV, figs. 1, 2, 3.) The fields on either side of the railway impress one as the greenest and cleanest meadows he ever saw. Scarcely a weed is in sight. (Pl. VII, fig. 1.) Planters say that the culture of berseem is very valuable for killing out many kinds of weeds. Not another fodder crop is conspicuous enough to attract one's attention as one gazes over the most beautiful agricultural checkerboard in the world. It is the one great fodder crop of Lower Egypt, and about it, as it were, all the other cultures are arranged. Over 940,000 acres of it were grown as far back as 1891. This amount has been probably considerably increased.

To an American farmer clover is only one of a number of fodder crops, but to the Egyptian fellah his berseem furnishes not only his principal fodder, but his principal manure as well.

The great fertility of the Nile silt and its manurial value has been so much written about that we have gotten accustomed to considering Egyptian agriculture as the tillage of a perpetually renewed alluvium. It will surprise some, especially farmers in the Mississippi Valley, to learn that this Nile soil is so lacking in nitrogen that in most places two good crops of Indian corn can not be raised in successive years off the same field, and the culture of sugar cane is considered much too exhausting for many Egyptian soils. This condition of affairs is not to be wondered at, considering that most of the manure has for centuries been collected by the "manure girls" and dried into cakes for fuel and only the liquid elements returned to the land, mixed with dry earth with which the stalls are strewn. This bad practice, carried on as it has been for thousands of years, would have, according to our present ideas, quite exhausted the fertility of the soil notwithstanding the yearly deposits of silt had it not been for the culture of leguminous crops. The action of soil bacteria is as yet too little understood to demand recognition in the above statement, although it is highly probable that bacteria play a most important part in the matter. The writer never saw a region where the opportunities for soil studies seemed so promising. According to Wilcox, in his Egyptian Irrigation of 1899, no important soil analyses of Nile silt have been made since 1875, and, so far as I know, no bacteriological examination has ever been made of it.

The ancient Egyptians doubtless cultivated several leguminous crops, although the museums of Egyptology do not exhibit their seeds because the plants seem in no way to have been connected with their

religious customs, and so far as discovered the bas reliefs of the tombs and monuments show no convincing evidences of their use. A bas relief in the tomb of Thy at Sakkara, of which a part is even illustrated in Baedeker's Egypt (p. 139), represents several calves tethered in a field of some forage plant or other in a manner quite resembling that of the present day. This bas-relief is about 4,500 years old. In the collection of seeds and dried plants in the Gizeh Museum which was made by Professor Schweinfurt is a small bowl of the seed of an unmistakable leguminous plant, probably a Medicago, from the temple of Isis at Dendera, which was, however, of comparatively recent times, being in the first Christian century.

Dr. Schweinfurt, who is an authority on the botany of Egypt and the ancient Egyptians, states that no picture, bas relief, name, or authentic seeds of berseem had ever been discovered in any of the tombs of Egypt. He discredited the correctness of certain finds made at Kahun by Flinders Petrie and identified by Percy Newberry as seeds of berseem, saying that there is in his mind a question as to whether these came from really ancient tombs. The name berseem bears a close resemblance to the Arabic name for lentil ("belsem" or "bersem"), and Dr. Schweinfurt thinks it not unlikely that when the Arabs conquered Egypt they applied this to the clover then cultivated in the country. The plant has nowhere been discovered wild, but a Byzantine variety (*Trifolium alexandrinum* var. *phleoides*, Boiss.) exists at Kilsali, near Smyrna, and it is probable that the plant was introduced into Egypt about the sixth century.

GENERAL USES.

Berseem is not only an annual clover, but it is a winter clover for warm countries where irrigation is practiced. Where the conditions of mild winter and abundant water supply for irrigation exist it can scarcely fail to prove a most profitable introduction, for it starts into growth with remarkable rapidity, outgrows most kinds of weeds, and yields one of the most palatable and nutritious green fodders known. Anyone having once seen it in Egypt can not fail to be impressed with its great value. It resembles quite closely when young our common alfalfa, but its flowering heads, although white, are in form like a loose-headed variety of red clover. (Pl. I and Pl. VI, fig 1.) The hollow stems are exceedingly succulent; in fact the whole plant is in every way more delicate than either clover or alfalfa, and it is eaten not only by domestic animals, but even by the fellahin.[a]

The root system of the berseem is not a large one, but remarkable for its abundant and succulent tubercules. (Pl. VIII, figs. 1 and 2; Pl.

[a] The writer is aware that the fenugreek, which resembles berseem somewhat, is a common green food of the peasants.

IX, figs. 1 and 2.) Being an annual and grown in general on irrigated land, it has not the faculty of going far in search of water, hence is not suited to cultivation on dry, arid soils, even though possessing a deep underlying layer of moister soil. The distinct differences between berseem and lucern or alfalfa must be insisted upon if the crop is to be made a success. (Compare roots of alfalfa and berseem, Pl. X.)

In Egypt, where both plants are grown—the alfalfa, however, only experimentally—the distinctions are very evident. The berseem is an annual and never grown more than nine months, while alfalfa is a perennial, which gets its full growth only in the second year. Berseem is planted in the autumn as late as October and cut in the late winter or early spring, from December to June, while alfalfa is planted in the spring (March to May), and cuttings are made in the summer and winter, or from April to December. The former is a short-lived winter-fodder plant for soils on which other crops are grown in the summer, while the latter is a perennial summer-fodder crop for rotations extending over several years or for permanent meadows.

Doubtless much of the continued fertility of the Nile soils may be attributed to the culture of this single crop, and nothing can be more striking than the dependence placed in it not only by the fellahin, but by the keenest modern cultivators in Egypt. It seems to be a sort of cure-all for the land, and no such thing as clover sickness from its culture is known. Until the Khedivial Agricultural Society endeavored to introduce artificial manures last year, nothing but the stable manure was employed, dependence being placed in the nitrogen stored in the soil by these tubercules. Mr. Wilcox, who is an authority on irrigation matters in Egypt,[a] said he had seen land steadily improve in fertility under a culture of half-year cotton and half-year berseem without the addition of any manures or fertilizers whatever. In his book on irrigation, p. 219, he remarks that—

> Berseem eats down salts if they are present in small quantities and enriches the soil with nitrates. * * * Many think that while cotton in summer is followed by clover (berseem) in winter, and cereals in winter are rigidly excluded, the rotation of cotton and clover can be carried on unlimitedly without any appreciable deterioration of the soil.

The cotton is planted in March and harvested in October and is followed by berseem, which is planted in October and plowed under in March.

Mr. Lang Anderson, manager of the Aboukir Land Company, who is reclaiming in the Nile delta over 30,000 acres of alkali land, says he is dependent upon berseem to bring up his soil, after the salt has been washed out of it, to a state of fertility suitable for cotton growing. The writer visited these remarkable reclaiming basins and saw

[a] W. Wilcox, author of "Egyptian Irrigation," which has already gone through a second edition. Now managing director of the Daira Sanieh Company in Cairo.

land on which cattle and horses were tethered and grazing in a luxuriant growth of berseem which two years before was as barren of vegetation as a bathing beach. (Pl. II, fig. 3.) The amount of nitrogen stored in the soil by the roots of this plant must have been considerable, for cotton was grown on it the third or fourth year.

Nothing could be more striking than the contrast between the roots of some alfalfa which I examined at several places in Egypt and those of this Egyptian clover. (Pl. X.) In the former the roots of both young and old plants were conspicuous for their freedom from tubercles, only an occasional almost microscopic one being observable, while the latter were often little less than a mass of these nitrogen-bearing bodies. (Pl. VIII, figs. 1 and 2; Pl. IX, figs. 1 and 2.) It is probable that the bacterium of the alfalfa nodule has not been introduced into Egypt and that it is distinct from the germ of the berseem tubercle. Possibly former trials with berseem in America have not succeeded well for a similar reason. It is expected that experiments which have been already started will solve this problem.

Too much stress can hardly be laid upon the necessity of a thorough study of the soiling value of this Egyptian clover, for its application to irrigated orchard lands in California and Texas may prove of the greatest importance. The Colorado Desert region, with its abundance of water, mild climate, rich soil, and other conditions for irrigation, seems an ideal place for the trial of this Egyptian culture, and if the rotation of crops can be adapted to its employment it should prove a great success. If Egyptian cotton can be made to succeed in this region, as is now hoped, this soiling crop will be of great value for a winter culture.

In the dry, irrigated regions of northern Africa, in Tunis and Algiers, this plant has already begun to attract the serious attention of the French experimenters. Mr. Gagey, of the Tunis Agricultural College, has tried it and is very enthusiastic over its quick growth and large production of green fodder. He was planning to secure seed for planting on a large scale. During the year in which the berseem was grown at the college in Tunis the thermometer sunk to nearly 2° below freezing, but the plant was not injured in the least. In the remarkable trial gardens of Dr. Trabut at Rouïba, in Algiers, the fields of berseem were among his most promising experiments, and a temperature of 9° below freezing (23° F.) did not injure them.

VARIETIES.

There are three distinct varieties of berseem known in Egypt[a] and their characters must be understood if one wishes to make a success of their introduction.

[a] Boissier gives *Trifolium alexandrinum* var. *phleoides* Boiss. as a variety occurring in Kilsali, near Smyrna, but says nothing as to whether it is in cultivation or not.

Muscowi (Pl. I), which is the variety commonly grown in the delta, where perennial irrigation is practiced and an abundance of water is always obtainable, is by far the most important of the three. It grows not uncommonly to a height of 5 feet and over (see Pl. IX, fig. 3), being the rankest grower of the three. It is broadcasted by the fellah or Egyptian peasant directly on the mud which is produced by flooding the land and allowing it to dry slightly. As much as a bushel of seed is sown per acre, but in the crude method of broadcasting a large amount of seed is wasted and a regular clover-seed sower could be used to advantage. In Egypt the seed is worth less than 5 cents a pound, or about the value of crimson clover, which it very closely resembles. Fully 10 per cent of Egyptian seed is, however, valueless, and it is, like all seeds in these warm climates, subject to weevils. The seed is raked in slightly to cover it and often in three days in Egypt the young plants are above ground. According to Mr. Lang Anderson as much as 10 per cent of the seed sometimes fails to germinate. The subsequent watering and attention depend somewhat on the condition of the land, but after each cutting a thorough irrigation is given, not immediately, but leaving sufficient time to elapse for the cut stubble to dry up and cure, otherwise the water will rot the newly cut stems and will often kill the plants. The sowing season varies from the 1st of September until the middle of January, according to location. If sown early in the autumn four cuttings can be secured, while only three are obtained when planted later; for although the plant may make but little growth above ground if sown in the cool autumn, it establishes itself and starts into a more vigorous growth in the early spring. A most important point in the culture of this crop is that it is injured by intense heat. Near Cairo, in early May, where the temperature had not gone above 92°, the berseem had begun to show signs of dying out, and by the 1st of June, the writer was informed, it would have almost entirely disappeared. A variety called *Kadrawi* is said to have a longer vegetative period, giving one more cutting than usual, but the writer has been unable to verify the statement. The Muscowi berseem, if planted in the early autumn, will give four cuttings. The first and second cuts will yield about 8 tons of green forage each, and the third and fourth only 6 tons apiece. When seed for next season's culture is required it is the practice to let the plants go to seed in June after the fourth cutting; otherwise often a fifth though inferior cutting is made. The yield of seed is much heavier than that of clover. When planted early the first cut may be taken in fifty days, but if the weather shortly after planting is cold, seventy days are required. The writer saw a field of late berseem planted January 5 which had been cut March 11, at which time it was 18 inches high. A second cutting was made April 7, and a third April 30, after which the roots were plowed under.

In some experiments carried on at the Algerian Experiment Station of Rouïba by Dr. Trabut, the seed was sown much earlier in the season and the yield was estimated as much higher. Sown on the 26th of July, the field was cut on the 12th of September, when it yielded at the rate of 28 metric tons to the hectare, equivalent to 14 tons per acre, while the second cutting of 13 tons, and the third of 15 tons, made the total of 42 tons of green fodder for three cuttings, as compared with 28 tons, the usual Egyptian yield for four cuttings. The better care given to the experimental plats and possibly a richer soil would account for the difference in yield in the two countries.

The profitableness of the crop as grown in Egypt depends largely upon the proximity of a market for the green fodder. Egypt is not a beef-producing country; from 10,000 to 15,000 head of cattle were imported annually up to a few years ago.[a] There are few large herds of cattle, and the dairy interests are in their infancy. Near Cairo, at Benisuif, the berseem fields are let for grazing or cutting purposes (Pl. XI, figs. 1 and 2) for £8 a feddan, which would be equivalent to about $38 an acre. At Gizeh £10, or about $48 an acre, are paid for the four cuttings, while even as high as $19 an acre per cutting is sometimes paid for especially luxuriant fields of berseem. It was learned that there was government land on which the rents amounted to only $40 an acre, upon which the berseem alone had sold for $42.50, leaving the summer crop to pay for management and the profits.

In Egypt there is a tradition that berseem can not be profitably planted in spring or before the 1st of October, because of the hot, dry weather between these dates; some of the more venturesome English experimenters, however, declare this tradition to be founded on superstition rather than fact, and recommend planting it as late as the last of April. In Algiers, Dr. Trabut has planted it in midsummer (the 26th of July) with good results.

The temperature records of Egypt for the months of June, July, and October (of an average season, 1895) are appended for purposes of comparison with the arid regions of this country, and from them it is evident that if the traditions regarding the deleterious effects of the hot season in Egypt were true it would be impossible that the crop would succeed if started in the hot summer of the Colorado Desert, for example. However, a few experimental plantings will probably be of more value than any study of temperature charts.

Month.	Temperature.			Relative humidity.	
	Mean.	Maximum.	Minimum.	Maximum.	Minimum.
	°F.	°F.	°F.		
June	+78	+103	+56	90	10
July	+82	+104	+66	91	13
October	+70	+ 90	+54	97	17

[a] McKenzie, in Journal of Khedevial Agricultural Society, Vol. I, No. 6, p. 259.

A comparison of the chemical analyses of green berseem and lucern has been made in Egypt, and it is given here to show how much more succulent the former is, containing 86.11 per cent of water, while lucern contains only 74.35 per cent. Berseem is poorer in nitrogen and starch, but also has less fiber in it than lucern. It is unfortunate that no analyses of the dry berseem are at hand, for the comparison of the green fodder alone does not give a fair idea of its food value.

Comparison of chemical analyses of green berseem and lucern, in Egypt.

	Berseem.	Lucern.
	Per cent.	*Per cent.*
Moisture	86.11	74.35
Albuminoids	2.29	4.35
Fats	.74	1.06
Starch, etc	5.78	9.62
Fiber	3.41	8.41
Ash	1.67	2.21

Fachl berseem (Pl. XII, fig. 1) is a variety used in Egypt on land which is irrigated by the basin system—i. e., overflowed for forty days in the autumn months from August until November, depending on the latitude and Nile overflow.

The seed is broadcasted at the rate of a bushel per acre on the Nile mud, which has been deposited from the meter or so depth of water which has stood over the land. No later irrigation is given it, and as a consequence it only gives one cutting. This cutting, however, yields 9 tons of green fodder per acre, and having more substance in it than the Muscowi, it makes a heavier hay. It is said to be fed extensively to donkeys. In order to get seed for planting it is often the practice to sow this variety mixed with wheat or barley and reap both together, separating the berseem seed from the grain only after the thrashing has been done. This variety is therefore a short-lived form and will prove of value on such lands as can be given only a single but heavy irrigation in the autumn.

The flood plains of the Colorado Desert region may some day be supplied with that remarkable system of basin irrigation (Pl. VII, figs. 2 and 3) which, although gradually disappearing from many parts of Egypt, is still acknowledged by experts like Mr. Wilcox to be the most wonderful of any, preserving the deposits of rich silt, which, by the perennial method, are largely lost. Such irrigation basins will be preeminently suited to the cultivation of this variety of berseem, and it may find a use as well on land under perennial irrigation where only one cutting is desired.

Saida is the name of a variety of berseem which, although yielding less than Muscowi, is relatively more nutritious. It possesses a com-

paratively long tap root (see Pl. XII, fig. 2) which enables it to thrive with much less water than is required for Muscowi, and it is, in fact, considered a kind of dry land berseem. It is sown in the basins but requires subsequent irrigation, as it yields two cuttings. Being a cheaper seed than that of the Muscowi, it is often sold in place of the latter. In habit it is lower and has a peculiar glaucous appearance, enabling one to distinguish it from the Muscowi. Its root system is abundantly supplied with tubercles and is eminently fitted to sustain the plant during prolonged droughts. It was observed growing luxuriously upon stiff Nile silt which was so baked and dried out that large cracks had formed in it to a considerable depth. On an average 6 tons only of green fodder is produced by the first cutting and 4 to 5 by the second or last. It is not sown to any extent in the Delta, but is common above Cairo. Experiments with this variety should be made on soils likely to suffer from drought, and even on land not under irrigation in regions depending on the natural rainfall, such as southern Texas, and Louisiana and Florida.

USE AS A GREEN FODDER.

The peculiar value of this crop lies in its use as a green fodder, and throughout lower Egypt there is scarcely an animal, either in the city or on the farms, which is not put on berseem for at least a month in the spring. Most marvelous fattening and conditioning properties are ascribed to it. Naturally the first effect upon an animal which has been fed all winter on chopped straw and barley is a purgative one (many cultivators mix a small amount of seed of fenugreek (*Trigonella fœnumgrecum*) with their berseem seed on sowing to increase the conditioning effect of the fodder) and weak animals are sometimes injured by the practice of tethering them all day long in the berseem fields, but, if strong enough to stand it, the scouring effect puts them in good condition and they are sent back to the stables in town in excellent flesh. It is a curious sight, that of a country with every beast of burden undergoing a sort of cure. In general, animals are not worked very steadily while on this green diet, as it is not sufficiently strong, and barley is often given work horses as an addition to the green fodder.

The small expense connected with the raising of this Egyptian clover and its effect in keeping the weeds in check are points decidedly in its favor. This latter property is more a matter of the frequent cuttings, which prevent weeds from seeding, than any effect of crowding out on the part of the clover. Although weeds grow with the usual astonishing rapidity in Egypt, in general there are fewer weeds than in any other agricultural region ever visited by the writer. Whether the berseem is responsible and how far for this clean culture will be hard to determine.

As a food for milch cows (Pl. III, figs. 2 and 3) one can imagine no sweeter or more delicate one, and from the samples of butter tasted on Mr. Zervudachi's place at Kafr. Dewar, it must be a most excellent milk producer. The large amount of water contained in the green food, however, may influence unfavorably the quality of the milk, making it poor in fats, and complaints in this regard were heard, but certainly for fine flavor the butter tasted was equal to the finest Finnish or Danish butter put on the London market.

BERSEEM AS A HAY CROP.

It would be a great mistake to underestimate the value of Egyptian clover as a hay crop. Great quantities of the cut clover are cured into hay or what the Egyptians call "drees" (Pl. VI, fig. 3) and stored for summer feeding, when a scarcity of green fodder makes the dried hay very acceptable.

Four to 5 tons of this freshly cut plant yield 1 ton of "drees," a curious brittle hay, snapping between one's fingers like pipestems, and apparently with scarcely any substance to it.

In comparison with alfalfa the freshly cut berseem has 89.61 per cent of water instead of 74.35 per cent, and only 3.41 per cent of fiber in place of 8.41 per cent. The percentage of albuminoids is correspondingly poor, being only 2.29 per cent as compared with 4.35 per cent. But notwithstanding the 15 per cent larger shrinkage, the value of the hay is sufficient to induce such men as Mr. Beyerlé of the Egyptian Crédit Foncier to grow it in fields large enough for American mowing machines (Pl. XI, fig. 3; Pl. XIII and XIV) and sulky rakes to operate in and by means of portable tramways to transport it to his barns. (Pl. V, figs 2 and 3; Pl. XIV.) No baled drees was seen, and baling does not appear to be commonly done in Egypt. Owners of properties some distance from the markets find it does not pay to grow berseem on all of their land not occupied, but, instead, let many acres go fallow.

The yield of hay per acre would vary according to the variety and cutting. Muscowi would yield for the first and second cutting $1\frac{3}{5}$ tons per acre each and for the third and fourth about $1\frac{1}{2}$ tons apiece, making for the four cuttings of the season $6\frac{1}{5}$ tons of dried hay per acre, which is $2\frac{1}{5}$ tons in excess of the maximum yield given for red clover in America, which is cut only twice.[a]

CONCLUSION.

In conclusion, the object of this bulletin is to call attention to a remarkable crop which, in Egypt, is of the very greatest importance

[a] Owing to lack of accurate data it was hard to ascertain the yield of drees per acre in Egypt. None could be found who had actually measured it. The figures given are those furnished by Mr. Bonaparte, of the School of Agriculture at Gizeh.

both as regards the value of its green and dried fodder and its fertilizing effect upon the soil, and if possible to introduce its culture into such regions of the United States as shall be suited to its profitable cultivation. A considerable quantity of seed has been secured through the kind assistance of Mr. George P. Foaden, of the Khédevial Agricultural Society of Cairo, for distribution by the Section of Seed and Plant Introduction, and experiments to test it are now under way. Previous experiments with the culture of berseem were based upon an insufficient knowledge of its peculiarities as a winter crop and their failure was practically assured from the start.

It is designed to have the plant tested as a half-year rotation for cotton in Texas, and in connection with the culture of the newly imported Egyptian cotton now being grown experimentally in Arizona and southern California. It is hoped also that it will find a place for itself as a winter soiling and fodder crop for orchards and vineyards in such regions as Arizona and California, where winter irrigation, which has been shown to be so beneficial by Professor McClatchie, is practiced. For spring forage, berseem may prove of value for the Northwest if planted after all danger of frost is over and harvested before the excessive heat of summer comes on, and the humid climate of Washington and Oregon may admit of its use in rotation with wheat, where now many thousands of acres lie fallow throughout the winter. Until careful tests have been made it will be impossible to say to which of these purposes it will prove best adapted.

DESCRIPTION OF PLATES.

Plate I.

Plant of Muscowi berseem in full flower. Natural size. From a photograph taken by Mr. C. S. Scofield of a plant in the trial gardens of Dr. Trabut at Rouïba, near Algiers.

Plate II.

Reclamation of salt lands by the aid of berseem. Fig. 1. Salt land of Aboukir estate near the seacoast of the Nile Delta before any attempts at reclaiming have been made. Fig. 2. Aboukir estate; fresh-water canal at right of picture; on the left, drain for salty water after it has been used for washing salt lands. Fig. 3. Horse feeding in field of berseem on salt lands of Aboukir the second year after the washing and reclaiming work has been begun.

Plate III.

Fig. 1. Water buffaloes feeding in a berseem field at Kafr. Dewar on the estate of Mr. Em. Zervudachi. Fig. 2. Cattle tethered in a berseem field near Cairo. Fig. 3. Cattle in barn, feeding on fresh berseem, at Mr. Beyerlé's estate at Bordein, Egypt.

Plate IV.

Fig. 1. Camels loaded with fresh berseem starting for Alexandria. From photograph taken by Mr. Brand, of Aboukir estate. Fig. 2. Early morning on the road from the Pyramids. Camels loaded with fresh berseem. Fig. 3. A donkey load of fresh berseem.

PLATE V.

Fig. 1. Taking green berseem to market. A donkey cart load of berseem which has just been watered to make it weigh more. Fig. 2. Making berseem hay or "drees." Tram wagonload of "drees," showing method of handling on the large estate of Mr. Beyerlé at Bordein. Fig. 3. Tram train of "drees" ready for the barns, Mr. Beyerlé's estate at Bordein.

PLATE VI.

Fig. 1. A field of berseem in full flower on Mr. Beyerlé's estate at Bordein. Fig. 2. Camel grazing in field of berseem, Aboukir estate. Fig. 3. A windrow of berseem hay or "drees."

PLATE VII.

Fig. 1. A field of berseem before flowering. Roadside near Alexandria. Fig. 2. The irrigation basins of Bedraschine, showing embankment dividing two large basins. Ruined native town in background. Fig. 3. Flood gates barring the entrance to the irrigation basins shown in Fig. 2.

PLATE VIII.

Fig. 1. Roots of Muscowi berseem, showing numerous root tubercles on the main and lateral roots. Slightly enlarged. Fig. 2. Roots of Muscowi berseem from a patch which had been cut but once. Natural size.

PLATE IX.

Fig. 1. Young plant of Muscowi berseem shortly after the first cutting, showing the base of the dead stem and the new living lateral shoots. Greatly reduced. Fig. 2. Roots of the plant shown in Fig. 1, showing the numerous tubercles. Natural size. Fig. 3. A single plant of Muscowi berseem from Mr. Beyerlé's estate at Bordein on April 14, 1901.

PLATE X.

Root of ordinary alfalfa on left and of Muscowi berseem on right, showing the great difference in habit of the two plants, and also the greater number of root tubercles on the berseem. Natural size.

PLATE XI.

Fig. 1. Cutting berseem by hand sickle and loading on donkey cart for the market. Fig. 2. Cutting berseem with a scythe; photographed by Mr. Brand, of the Aboukir estate. Fig. 3. Cutting berseem with an American mowing machine on the estate of Mr. Beyerlé, Bordein, Egypt.

PLATE XII.

Fig. 1. Plant of Fachl berseem gone to seed, showing the dry heads and shriveled leaves. Gizeh irrigation basin near the Great Pyramids. Photograph taken May 1, 1901. Fig. 2. Plant of Saida berseem in full bloom, showing the long taproot. From the Gizeh irrigation basin near the Great Pyramids. Photograph taken May 1, 1901.

PLATE XIII.

American mowing machine and rake in a field of berseem on the estate of Mr. Beyerlé at Bordein, Egypt.

PLATE XIV.

Loading trams with berseem hay on estate of Mr. Beyerlé at Bordein, Egypt.

MUSCOWI BERSEEM.

FIG. 1.—ORIGINAL ASPECT OF SALT LANDS.

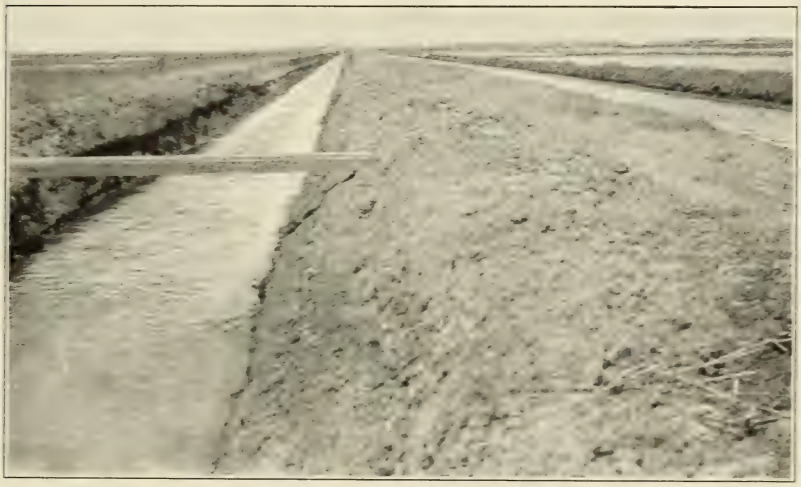


FIG. 2.—DITCHES IN SALT LANDS.

FIG. 3.—GROWTH OF BERSEEM ON SALT LANDS.

RECLAIMING SALT LANDS WITH THE ASSISTANCE OF BERSEEM.

FIG. 1.—CATTLE GRAZING IN FIELD OF BERSEEM.

FIG. 2.—CATTLE GRAZING IN FIELD OF BERSEEM.

FIG. 3.—BERSEEM USED AS A GREEN FODDER CROP.

BERSEEM USED AS A PASTURE AND GREEN FODDER CROP.

FIG. 1.—CAMELS CARRYING GREEN BERSEEM TO MARKET.

FIG. 2.—LINE OF ANIMALS LOADED WITH GREEN BERSEEM.

FIG. 3.—DONKEYS TRANSPORTING GREEN BERSEEM.

BRINGING GREEN BERSEEM TO MARKET.

FIG. 1.—TAKING GREEN BERSEEM TO MARKET.

FIG. 2.—TRAIN WAGONLOAD OF "DREES."

FIG. 3.—TAKING BERSEEM HAY OR "DREES" TO THE BARN.

FIG. 1.—BERSEEM IN FULL FLOWER.

FIG. 2.—CAMELS GRAZING IN FIELD OF BERSEEM.

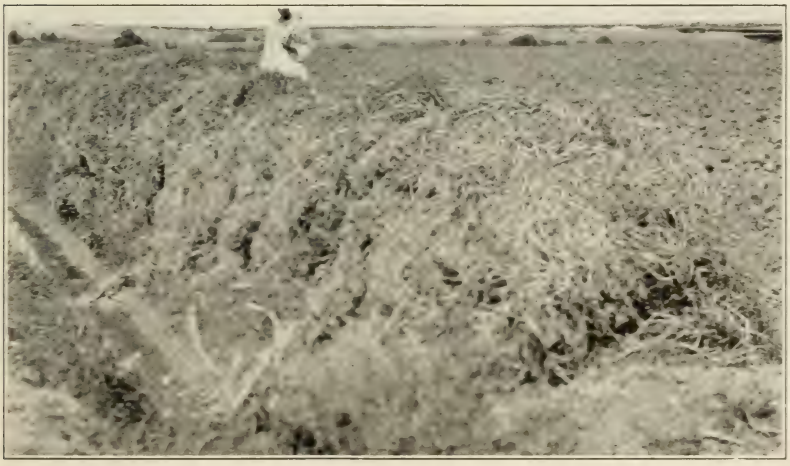


FIG. 3.— A WINDROW OF BERSEEM HAY OR "DREES."

FIG. 1.—FIELD OF BERSEEM BEFORE FLOWERING.

FIG. 2.—EMBANKMENT DIVIDING TWO IRRIGATION BASINS.

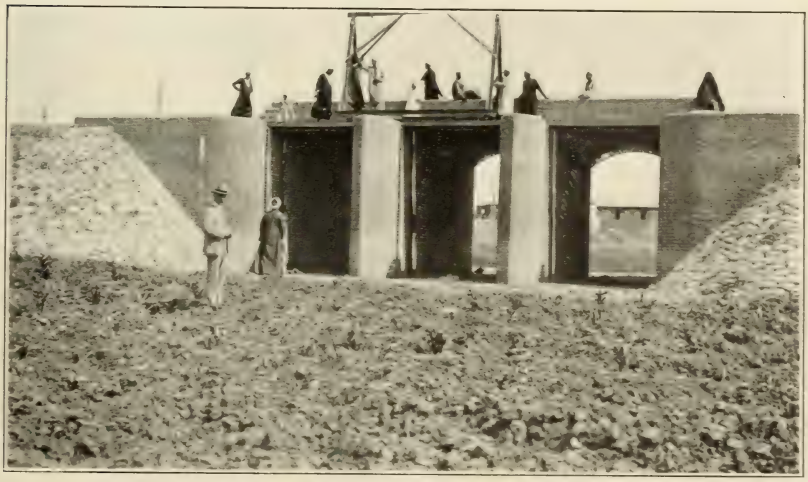


FIG. 3.—FLOOD GATE FOR IRRIGATION BASINS SHOWN IN FIG. 2.

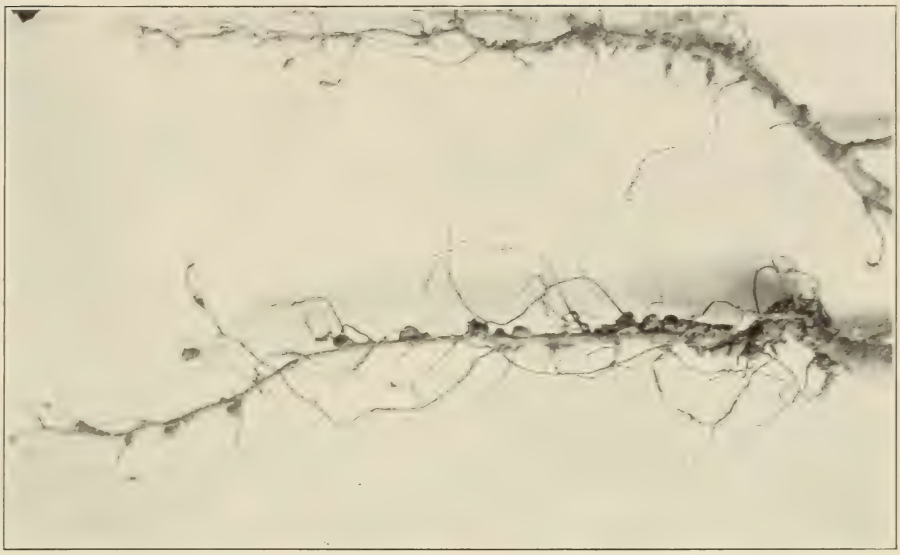


FIG. 1.—ROOTS OF MUSCOWI BERSEEM, SHOWING TUBERCLES ON MAIN AND LATERAL ROOTS. SLIGHTLY ENLARGED.

FIG. 2.—ROOTS OF MUSCOWI BERSEEM TAKEN AFTER FIRST CUTTING. NATURAL SIZE.

Bul. 23, Bureau of Plant Industry, U. S. Dept. of Agriculture.

FIG. 1.—YOUNG PLANT OF MUSCOWI BERSEEM SHORTLY AFTER THE FIRST CUTTING. REDUCED TO THREE-EIGHTHS. NATURAL SIZE.

FIG. 2.—ROOTS OF PLANT SHOWN IN FIG. 1. NATURAL SIZE.

FIG. 3.—PLANT OF MUSCOWI BERSEEM, SHOWING HEIGHT IT ATTAINS.

ROOTS OF ORDINARY ALFALFA (ON LEFT) AND MUSCOWI BERSEEM (ON RIGHT).

FIG. 1.—CUTTING BERSEEM WITH HAND SICKLE AND LOADING A CART FOR MARKET.

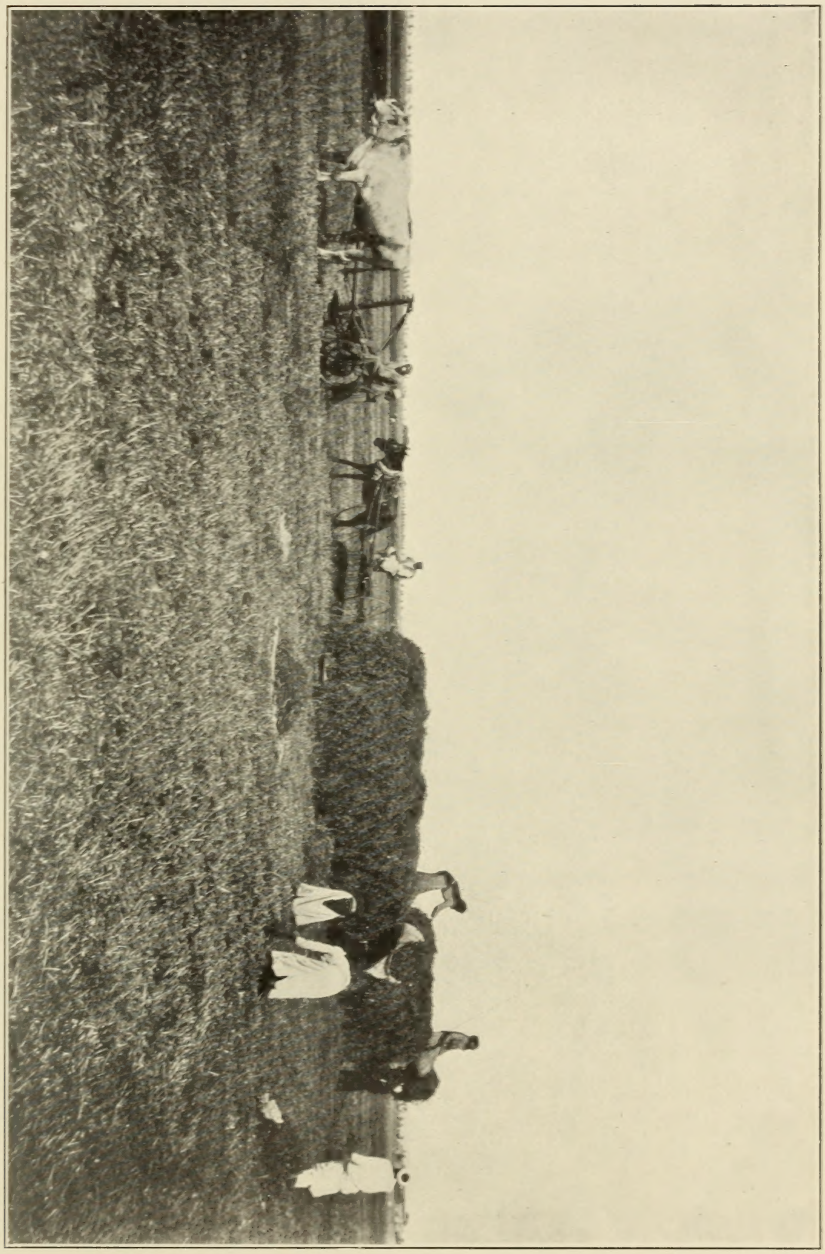
FIG. 2.—CUTTING BERSEEM WITH SCYTHE.

FIG. 3.—CUTTING BERSEEM WITH AMERICAN MOWING MACHINE.

FIG. 1.—PLANT OF FACHL BERSEEM ALREADY GONE TO SEED, MAY 1, 1901.

FIG. 2.—PLANT OF SAIDA BERSEEM IN FLOWER, MAY 1, 1901. REDUCED TO TWO-SEVENTHS NATURAL SIZE.

AMERICAN MOWING MACHINE AND RAKE IN A FIELD OF BERSEEM ON THE ESTATE OF MR. BEYERLÉ AT BORDEIN, EGYPT.



LOADING TRAINS WITH BERSEEM HAY ON ESTATE OF MR. BEYERLE AT BORDEIN, EGYPT.

BULLETINS OF THE BUREAU OF PLANT INDUSTRY.

The Bureau of Plant Industry, which was organized July 1, 1901, includes Vegetable Pathological and Physiological Investigations, Botanical Investigations and Experiments, Grass and Forage Plant Investigations, Pomological Investigations, and Gardens and Grounds, all of which were formerly separate divisions, and also Seed and Plant Introduction, The Arlington Experimental Farm, Tea Investigations and Experiments, and the Congressional Seed Distribution. Beginning with the date of organization of the Bureau, the independent series of bulletins of the Division of Vegetable Pathology and Physiology, the last number of which was 29, and of each of the other Divisions were discontinued, and all are now published as one series of the Bureau.

The bulletins published in the series are:

No. 1. The Relation of Lime and Magnesia to Plant Growth. 1901.
2. Spermatogenesis and Fecundation of Zamia. 1901.
3. Macaroni Wheats. 1901.
4. Range Improvement in Arizona. 1901.
5. Seeds and Plants Imported through the Section of Seed and Plant Introduction, Inventory No. 9, Nos. 4351–5500. 1902.
6. A List of American Varieties of Peppers. 1902.
7. The Algerian Durum Wheats: A Classified List, with Descriptions. 1902.
8. A Collection of Economic and other Fungi Prepared for Distribution. 1902.
9. North American Species of Spartina. 1902.
10. Records of Seed Distribution and Cooperative Experiments with Grasses and Forage Plants. 1902.
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20. Manufacture of Semolina and Macaroni. 1902.
21. List of American Varieties of Pepper. 1902.
22. Injurious effects of Premature Pollen, etc. 1902.